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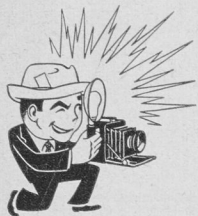
Farm Science **REPORTER**

Vol. 6, No. 1

Iowa State College, Ames, Iowa

January, 1945





The AUTHORS

H. R. MELDRUM brings together some of the important facts about phosphorus fertilizers and its use in Iowa. Although "Jerry" Meldrum was reared on a South Dakota farm, he came with his family to Iowa in 1919 and has lived here most of the time since. He is a graduate of Iowa State College, having majored in soils. He spent a year on his mother's farm in South Dakota after finishing college and was with a commercial dairy in California about a year. Except for those periods he has been with Iowa State College continuously, having worked with both the Extension Service and the Experiment Station.

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CARL BLICKENSTAFF, a former Indiana farm boy and a graduate of Purdue University, is research associate at the Iowa Station. His work recently, like that of Dr. Harris, has been with the corn borer.

KIRK LAWTON is from Minnesota. He graduated from the college of agriculture at Minnesota University and has done graduate work at Michigan State College. He is now working to complete his Ph.D. degree at Iowa State College.

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IVER J. JOHNSON—he's from a farm in the Red River Valley of Minnesota. Dr. Johnson did all of his college work at the University of Minnesota. When he completed college he became a member of the staff of the College of Agriculture at the University of Minnesota, working in agronomy and plant genetics. His special studies were with corn breeding and forage crops. He was in that work from 1930 to 1939 and came to Iowa State College Jan. 1, 1940. His principal work here is with forage crops. He is also assisting Director R. E. Buchanan at present with administrative work of the Iowa Station.

Other authors in this issue who have been previously introduced to the readers are W. H. PIERRE, head of the Agronomy Section and Soils Subsection of the Station; C. J. DRAKE, head of the Economic Zoology and Entomology Section of the Iowa Station and state entomologist of Iowa; C. A. BLACK, research assistant professor in soils; C. P. WILSIE, research associate professor in farm crops; H. D. HUGHES, head of the Farm Crops Subsection; JOE L. ROBINSON, member of both the Extension Service and Experiment Station staffs in farm crops and secretary of the Iowa Corn and Small Grain Growers' Association; E. S. HABER, head of the Vegetable Crops Subsection.

"NOW WE ARE SIX"

With this issue Farm Science Reporter begins its sixth year. Volume 5 is complete, and you have in your hands the first number of volume 6.

We had hoped by this time the war would be over and we would see our way clear to issue the Reporter bi-monthly so that you might expect to have an issue every two months instead of every three months as at present. Until there is more help available it does not seem wise to attempt to produce six issues each year.

How well Farm Science Reporter has filled your hopes or expectations we do not know. Many of you have had nice things to say about the publication and its value to you and others have helped us by pointing out weaknesses.

We hope that you will continue to tell us of your feelings about the publication and to ask for the things you want. We cannot always fulfill your requests, but we want them anyway.

The Iowa State College is very much your institution and this avenue of issuing information from the Iowa Agricultural Experiment Station and Iowa Agricultural Extension Service should be guided by your wishes. Farm Science Reporter was started at the request of a group of Iowa farmers who studied the publication setup at Iowa State College. By your guidance we hope to continue to improve the Reporter and make it of more value to you.

WANT THE NEXT ISSUE?

The mailing list of the Reporter is being revised with this issue in accordance with law. Therefore you had better return the card if you want to receive the April issue. Those who do not return their cards and those who forget to sign their names on the cards they return will not get the next issue.

HOW ABOUT THE IOWA FARM ECONOMIST?

If you are not getting the "older sister" of the Farm Science Reporter—the Iowa Farm Economist—you should find it of interest and value to you. It deals with the economic side of the farming business—and that is pretty important. The mailing list of the Economist was revised in December and if you did not return your card, you won't be getting it from now on. It is issued monthly.

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FARM SCIENCE REPORTER

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Know Your Phosphates!

By H. R. MELDRUM

With Shortage of Superphosphate, Other Phosphate Fertilizers May Be Considered

IF WE ARE to keep up crop yields and quality, many of our soils must have phosphate fertilizer. If we can't get enough superphosphate because of the war, then what about the other phosphate fertilizers? Can they "pinch hit" for superphosphate?

We have done a lot of comparing results of superphosphate with rock phosphate here at the Iowa Station, and Station workers in cooperation with farmers have made many tests over Iowa on several different soil types. From these many years of testing, here are our conclusions and recommendations:

Results, Recommendations

1. Superphosphate generally gives higher increases in crop yields than rock phosphate. On certain soils, however, especially with legume crops, rock phosphate has given good results.
2. Only slight response is obtained with rock phosphate the first year, while superphosphate gives immediate returns.
3. Rock phosphate is more effective on acid than on limed or neutral soils, but it cannot take the place of lime.
4. Rock phosphate is cheaper

per unit of total phosphorus than superphosphate but much larger amounts are required because of its low availability.

5. The best place for rock phosphate is with alfalfa and clover seedings, particularly sweet clover. The rate recommended is 500 to 800 pounds per acre.

6. Twenty percent superphosphate (0-20-0) should be used at from 150 to 200 pounds per acre for small grain and biennial legume seedings such as red clover and sweet clover. When alfalfa is seeded we recommend from 250 to 300 pounds per acre.

7. For corn we recommend about 100 pounds per acre of 20 percent superphosphate, or of a mixed fertilizer containing superphosphate, applied with a corn planter attachment at planting time. When broadcasting superphosphate for corn, about twice as much is necessary.

8. The supply of superphosphate during wartime will not meet the demand, and rock phosphate may well be used, especially for legume seedings where the soil is not alkaline or the acidity has not been fully corrected by liming.

Lack of available phosphorus slows down plant growth, delays maturity and lowers the yield and quality of crops. Phosphorus is one element that is rapidly removed from the soil either in livestock or grain farming. Animals use the phosphorus in the feed they eat to build their bones—their bodies. We cannot avoid eventually having to replace this phosphorus which we are continually removing with any type of farming.

Only a small part of the phosphorus in our soils is available for plant use in any one year. So the availability of phosphate fertilizer applied is of importance if we are looking for quick returns. Phosphorus must be soluble to enable plants to use it. If one understands the characteristics of the various phosphate fertilizers, he is not so likely to be "taken in" by sales talk.

Phosphate Fertilizers

Rock phosphate is a finely ground phosphate-bearing rock, containing from 30 to 33 percent total phosphoric acid. Only a small amount of the phosphorus in it is readily available to crops—the

Here is how alfalfa responds to phosphate fertilizer. This is on the farm of Dave Hunter, Hamilton County. That which was limed only (left) had made a growth of approximately 1 foot when an adjoining area (right) which had received 100 pounds of triple-superphosphate (0-45-0) in addition to lime at the time of seeding was about 2 feet tall. The field was seeded in 1939, the photos made in 1940.





Rock phosphate brings about as good results as superphosphate on some soils as shown in the top and bottom photos (above) of timothy and red clover on the farm of H. E. Hazen, Denmark, Iowa (Lee County). The center photo shows the plot that did not receive lime, manure or phosphate. Corn yields on rock and superphosphate plots increased about 8-9 bu.

amount varying with different soils and crops. Legume crops such as red clover, alfalfa and sweet clover have a greater ability to use the phosphate in rock phosphate than the grain crops. Rock phosphate is less available in well-limed, neutral or alkaline soils than in acid soils, and it ordinarily should not be used on neutral or alkaline soils.

Rock phosphate has a place in a long-time soil-building program on some soils, but because of its slow availability, do not expect quick returns from it. Rock phosphate has no appreciable effect in correcting soil acidity, and there are no experiments indicating that the small amounts of other minerals in rock phosphate are of any direct benefit to crops and soils.

Superphosphate, a commercial product obtained by mixing rock phosphate with sulfuric acid, contains phosphorus in a form quickly available to plants. It is the most commonly used phosphate fertilizer. Superphosphate is usually sold under the label of 0-18-0 or 0-20-0, the middle figure designating the total amount of **available** phosphoric acid it contains. Higher analysis superphosphates are available in limited amounts.

Colloidal phosphate is a finely divided, relatively low grade type of rock phosphate or phosphate clay. It usually contains from 18 to 23 percent **total** phosphoric acid, with only a small amount readily available to plants. Experiments in some states have shown that colloidal phosphate has about the same fertilizing value as rock phosphate when it is applied on a phosphorus-equivalent basis.

Since colloidal phosphate contains only about two-thirds as much total phosphoric acid as rock phosphate, it has less value, ton for ton, and should be applied at a correspondingly higher rate than rock phosphate. If you consider buying colloidal phosphate, be sure to consider the comparative prices per unit of phosphoric acid with what it would cost you in rock phosphate.

Long-Time Experiments

Rock phosphate and superphosphate have been compared in

many experiments in Iowa. In early tests no attempt was made to apply the fertilizers on a phosphate-equivalent basis or equal money value basis. As a result, larger amounts of rock phosphate were used than we now recommend.

Table 1 is a summary of 20 years of experimental work with rock phosphate and superphosphate on 16 fields showing a definite response to phosphate and representing seven of the principal soil types of Iowa.

The soil types represented in this comparison were Carrington loam, Carrington silt loam, Clarion loam, Marshall silt loam, Grundy silt loam, Clinton silt loam and Waukesha silt loam.

In all but one comparison the average increase from superphosphate has been larger than that from rock phosphate, when used either with or without manure. The yield increase from both fertilizers was greater in all cases on manured than unmanured soils. The nitrogen added in the manure undoubtedly accounts for this.

Short-Time Experiments

In more recent experiments we have compared rock phosphate at two or three different rates with superphosphate at one rate. The standard rate for superphosphate has been 200 pounds per acre of 0-20-0 in a 3-year rotation of corn, oats and clover. Rock phosphate has been used on some fields on a phosphorus-equivalent basis, or 125 pounds per acre, as well as at 375 pounds per acre, representing about three times the phosphorus equivalent of superphosphate and about equal money value. Rock phosphate at 1,000 pounds per acre has been used on some fields as compared to 375 pounds.

In table 2 a summary of the relative response to rock phosphate and superphosphate is shown. The data represent results obtained on nine different soil types. Seven of the fields were limed, one was unlimed and one was nearly neutral in reaction.

In all but one case superphosphate increased the crop yield more than rock phosphate. In



Top: Manure, lime and superphosphate (120 pounds of 0-20-0 at time of seeding) boosted the oat yield 30 bushels an acre and nearly doubled the hay (alfalfa-red clover-timothy) yield over the check plot (center) which received no treatment. Bottom: Manure and lime alone lifted the oat yield 10 bushels and increased the hay yield about $\frac{1}{2}$ ton per acre.

TABLE 1. RESPONSE OF DIFFERENT CROPS TO ROCK PHOSPHATE AND SUPERPHOSPHATE, WITH AND WITHOUT MANURE ON LIMED SOILS, IOWA AGRICULTURAL EXPERIMENT STATION—20 YEARS RESULTS.*

Crop		Average increased yields, bu. or lbs. per acre			
		In addition to manure and lime		Lime, but not manure	
		Rock phosphate	Super-phosphate	Rock phosphate	Super-phosphate
Corn	64 crops	4.7 bu.	5.7 bu.	2.1 bu.	2.1 bu.
Wheat	25 crops	4.9 bu.	5.9 bu.	4.2 bu.	5.7 bu.
Oats	68 crops	4.7 bu.	8.3 bu.	4.6 bu.	6.3 bu.
Red clover	39 crops	735 lbs.	920 lbs.	590 lbs.	760 lbs.
Alfalfa	43 crops	485 lbs.	770 lbs.	470 lbs.	600 lbs.

*The average annual fertilizer application and approximate cost of fertilizer per acre were: Rock phosphate 250 pounds costing \$2.25 (\$18 per ton) and superphosphate, 90 pounds of 0-20-0 costing \$1.15 (\$26 per ton).

Rock phosphate was applied once in a 4-year rotation (1000 lbs.) at the time of turning under the sod for the first corn crop, while superphosphate was applied to all grain crops. Manure was applied at the rate of 8 tons per acre once in a 4-year period. Limestone was applied according to soil tests.

TABLE 2. RELATIVE RESPONSE TO ROCK PHOSPHATE AND SUPERPHOSPHATE ON FIELDS SHOWING A DEFINITE RESPONSE TO PHOSPHATE, IOWA AGRICULTURAL EXPERIMENT STATION, 1937 TO 1944.

Crop		Average increased yields, bushels or pounds per acre			
		Super-phosphate 200 lbs. 0-20-0	Rock phosphate 125 lbs. per A.	Rock phosphate 375 lbs. per A.	Rock phosphate 1000 lbs. per A.
Oats	3 fields	5.1 bu.	0.7 bu.	1.5 bu.	no plots
Oats	4 fields	6.5 bu.	no plots	4.2 bu.	4.2 bu.
Red clover	2 fields	400 lbs.	200 lbs.	240 lbs.	no plots
*Red clover	2 fields	740 lbs.	no plots	700 lbs.	940 lbs.
Alfalfa (4 cuttings)	2 fields	540 lbs.	220 lbs.	320 lbs.	no plots

*One field was on a medium acid Carrington silt loam.

Approximate cost of fertilizers per rotation: Superphosphate, 200 lbs. 0-20-0—\$3; rock phosphate, 125 lbs.—\$1; rock phosphate, 375 lbs.—\$3; rock phosphate, 1000 lbs.—\$8.

TABLE 3. INCREASED YIELDS FROM SUPERPHOSPHATE AND ROCK PHOSPHATE ON A MEDIUM ACID SOIL, COMPARED WITH THE INCREASES ON A NEARLY NEUTRAL SOIL.

Crop	Medium Acid Soil Carrington Silt Loam Cedar Rapids, 1942-1944			Nearly Neutral Soil Webster Silty Clay Loam Ames, 1943-1944		
	Super-phosphate 200 lbs. 0-20-0	Rock phosphate 375 lbs.	Rock phosphate 1,000 lbs.	Super-phosphate 200 lbs. 0-20-0	Rock phosphate 375 lbs.	Rock phosphate 1,000 lbs.
Oats	7.5 bu.	3.3 bu.	1.3 bu.	5.0 bu.	2.9 bu.	4.8 bu.
Red clover	380 lbs.	780 lbs.	1060 lbs.	1100 lbs.	620 lbs.	800 lbs.

general, legume crops have shown a greater response to rock phosphate than the grain crops. Superphosphate has been more profitable than rock phosphate both when used in phosphorus-equivalent amounts and in equivalent money value amounts.

Acid, Neutral Soils

It is generally recognized that rock phosphate has a greater effect on acid soils than superphosphate. A comparison of the fertilizers on two different soils is shown in table 3.

In general the response to rock phosphate was greater on the Carrington silt loam, an acid soil, than on the Webster silty clay loam, which was near neutral in reaction. This does not mean that rock phosphate can take the place of lime on acid soils, but means that rock phosphate is a more effective carrier of phosphorus on acid soils than on limed or neutral soils. However, for the successful growing of crops like alfalfa and sweet clover, lime is essential.

A Final Word

Both superphosphate and rock phosphate have a place in the Iowa fertilizer program. Until the war ends there is not likely to be enough superphosphate to meet all demands. Rock phosphate can well be used for legume seedings on many acid soils where the acidity has not been fully corrected with lime. It should generally not be used on alkaline or neutral soils. Superphosphate should be used in all cases where immediate returns are expected, and where soils are neutral or alkaline in reaction.

EARLYANA PROMISING SOYBEAN

One of the promising new soybean varieties for northern Iowa is the Earlyana. In seven tests in northern Iowa from 1941 to 1943, inclusive, it has outyielded Richland an average of about 2 bushels an acre and has matured an average of 3 days earlier.

But one of the strong points of Richland—the ability to stand up—is not so good in the Earlyana. The Earlyana seed will not be generally available in Iowa for a year or two.

This variety was developed at the Indiana Station. It grows 5 to 6 inches taller than Richland and is adapted to the less fertile soils of northern Iowa.

It is not unusual in good seasons for the better strains of brome grass to produce 400 to 500 pounds of seed to the acre.

Methods of Applying Fertilizer



A new method of applying fertilizer in large amounts is with attachment on plow. Note band of fertilizer in the bottom of the furrow.

By W. H. PIERRE

HOW CAN WE use our limited supplies of fertilizer most effectively? Not only is this a question in the minds of many farmers now, but it is an important problem from the standpoint of the nation's total production.

The efficient use of fertilizer requires more than just "getting it on the soil." Just as the efficiency of a car, measured in miles per gallon, is determined as much by the adjustment of the carburetor or the manner in which the gas enters the cylinder head as by the quality of the gasoline, so also is the return from fertilizers often determined as much by the method and time of application as by the kind that is used.

Five Methods of Applying

There are five general methods of applying fertilizer. These are: (1) Broadcasting before seeding, (2) drilling in narrow bands before or at time of seeding, (3) applying in hill or row at time of planting row crops, (4) top-dressing while the crop is on the ground and (5) applying fertilizer at time of plowing.

In determining which of these methods will be most effective for

a given condition the question to be answered is which method applies the fertilizer in such a manner that plant roots can take up as large a proportion of it as possible when needed by the crop. Ordinarily, this means getting the fertilizer at least 2 inches deep, so that it may be near the plant roots and below the periodically dry surface.

Nitrogen fertilizers move readily down into the soil with the soil water. In general, however, fertilizers containing phosphorus or potassium tend to remain where placed in the soil and move downward very slowly. So it is important where the fertilizer is placed, because the fertilizers used in the state consist largely of phosphates or phosphate-potash mixtures.

With Small Grain, Legumes

Small seeded legumes, such as clover and alfalfa, respond well to fertilizers. Moreover, good stands and growth of legumes help to supply nitrogen for the other crops in the rotation. For this reason, much of the fertilizer used in the rotation should ordinarily be applied at the time of seeding the legume, or the legume-nurse crop combination.

Drill or Broadcast?

The most effective method of applying phosphate or mixed fertilizer to legume seedings, either with or without small grain nurse crop, is by the use of the combi-

nation grain-fertilizer drill. (See illustration.) The drill delivers the fertilizer in narrow bands along the drill rows and places it approximately 2 inches deep. Moreover, the fact that the fertilizer is in bands means that more of it remains available to the crop than when applied broadcast. Very few farmers, however, have fertilizer drills. The common method of applying fertilizer for small grain and legume seedings, therefore, is broadcasting by means of a regular fertilizer spreader, an endgate seeder, or a low-type lime spreader. Of these, the latter two are most commonly used. (See illustration.)

Spread Evenly, Disk Well.

Broadcasting, as often done, is a relatively inefficient method of spreading fertilizer. In the first place, fertilizer spread with an endgate seeder or lime spreader is often spread unevenly, especially if it is applied during windy weather and if not enough care is taken to overlap sufficiently. It is quite common to see fields where the clover, alfalfa or other crop appears in streaks due to uneven distribution of the fertilizer. An example of uneven broadcasting of fertilizer on a hemp crop in northern Iowa is shown in the accompanying picture. Note that the hemp is over twice as tall in the strips that had received the largest amount of fertilizers.

The regular fertilizer spreader which drops the fertilizer on the ground spreads it quite uniformly. It is therefore much to be pre-

Distributing fertilizer with an endgate seeder or lime spreader often brings results such as in this hemp field. Note the uneven growth of the crop in the background up over the hill.



ferred to the endgate seeder or rotary type lime spreader which scatters the fertilizer in a wide strip.

Another problem with a broadcast application is that the fertilizer is often not worked deep enough into the soil. Ordinarily, one should disk at least twice after the fertilizer is broadcast.

Fertilizing Row Crops

Much work has been done in different parts of the country on the best methods of applying fertilizer for row crops. In the eastern part of the Corn Belt, corn is generally fertilized, and in recent years considerable fertilizer has been used on corn in northeastern Iowa. Soybeans respond poorly to fertilizer and, therefore, receive very little. On the other hand, the sugar beet crop, grown on a relatively small acreage in north-central Iowa, responds very well to fertilizers and is generally fertilized.

Row Versus Broadcast Methods. The two most common methods of applying fertilizer for corn and other row crops in Iowa are (1) broadcasting and (2) row or hill application. Of these two methods, the row or hill method of application is much more efficient.

The row or hill application is made at the time of planting the corn by means of a fertilizer attachment on the corn planter which distributes the fertilizer in

One of the most effective methods of applying fertilizer is with a combination grain-fertilizer drill.

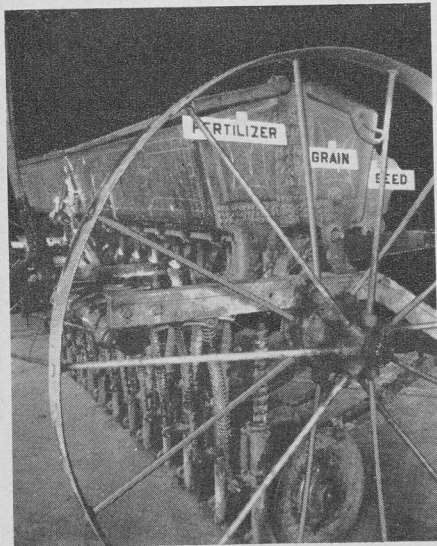


TABLE 1. COMPARISON OF ROW, BROADCAST, AND OF PLOWED-UNDER METHODS OF FERTILIZATION ON YIELD OF SUGAR BEETS.

Amount of fertilizer and method of application	Yield in tons per acre			
	0-20-0 fertilizer	0-20-20 fertilizer	Average	Increase
No fertilizer	.....	.....	10.3	.....
125 pounds, in row	12.6	13.1	12.85	2.55
125 pounds, broadcast	11.6	11.9	11.75	1.45
250 pounds, broadcast	12.5	13.0	12.75	2.45
500 pounds, broadcast and plowed under	12.6	13.3	12.95	2.65

two narrow bands on either side of the seed. (See illustration.) By proper adjustments, the fertilizer can be placed as deep as the seed or in a position where it is readily available to the young plant.

Many field tests have shown that only about one-half as much fertilizer is needed when applied in the hill or row as when applied broadcast. This is well illustrated in some data we obtained with sugar beets on Webster silty clay loam near Kanawha in 1942. (See table 1.) As an average for the two fertilizers tried, it was found that 125 pounds applied in the row increased the yield 2.55 tons per acre; whereas the same amount of fertilizer broadcast increased the yield only 1.45 tons. You will note in table 1 that it took twice as much fertilizer when applied broadcast as when applied in the row to get the same yield increase.

There are several reasons why the fertilizer is more efficient when applied in the hill or row than when broadcasted. One reason, as previously mentioned, is that the fertilizer is applied deeper in the soil. The other very important reason is that phosphorus and potassium fertilizers rapidly combine with the soil, to form compounds less soluble and therefore less available to plants. This process is known as "fixation."

Fixation is much greater when the fertilizer is broadcast than when applied in the hill or row. This is what would be expected because the fertilizer comes in con-

tact with much more soil when broadcast. A greater proportion of the fertilizer, therefore, combines with the soil and becomes less available to plants. In other words, the action of the soil on the fertilizer is something like the action of a dry sponge on water. A small amount of water absorbed by a large sponge is held much more tightly and cannot be squeezed out as readily as the same amount of water taken up by a small sponge.

Ordinarily, the amount of fertilizer applied in the hill or row for corn is quite small, the average rate probably not exceeding 100 pounds per acre. This means, of course, that there is less residual effect on the succeeding crops than if twice as much fertilizer had been applied broadcast. It is ordinarily much better, however, to apply the smaller amount of fertilizer for corn in the row and to apply more fertilizer to the legume seeding that often follows corn in the rotation than to expect the legume crop to depend for part of its needs on the amount left over from the corn crop. For example, it would be much better in a 3-year rotation of corn, oats and clover to apply 100 pounds of fertilizer for corn in the hill and 200 pounds for oats seeded to a legume than to apply 200 pounds for corn broadcast and have only 100 pounds left for the oats and clover seeding.

Problems in Hill Fertilization. One point that needs to be



When small amounts of fertilizer are being used, they give best results if applied in the hill or row with a planter attachment. The fertilizer should go into the soil at least as deep as the seed is being planted.

checked when applying fertilizer by means of the attachment to the corn planter is to see that the adjustments are such that the fertilizer is not left on the surface. The fertilizer should be placed in the soil, preferably as deep as the seed.

Many of the early corn planter attachments for distributing fertilizer were not very satisfactory because they allowed fertilizer to come in contact with the seed. This often caused a reduction of stand, especially in a dry year. The attachments that have been on the market for about the past 10 years, however, distribute the fertilizer in narrow bands on either side of the seed and are very satisfactory.

Side Dressing. Where a larger amount of fertilizer is used than is applied at planting time, an application is sometimes made along the row after the plants are up or are still small. The fertilizer can be applied by means of a fertilizer attachment to the cultivator, the fertilizer being delivered immediately back of the cultivator shovels nearest the row. (See illustration.) This method has been used to a limited extent in Iowa to apply potassium fertilizers on high-lime or so-called "alkali soils" and it can also be used in applying nitrogen fertilizers. The advantage of this method is that the amount of fertilizer can be varied, depending on the stand that is obtained and the growing conditions. If the stand is poor or the soil very

dry there is less likelihood of returns from fertilizer than with a good stand and a favorable soil moisture condition.

Plowing Under Fertilizer

During recent years there has been considerable interest in the possibility of plowing under fertilizer for corn and soybeans when large amounts are needed. An at-

tachment for the plow which distributes the fertilizer in a narrow band at the bottom of the plow furrow has been placed on the market. (See illustration.)

During 1943 and 1944 we carried on several experiments to study the comparative value of plowing under and broadcasting large amounts of fertilizer for corn and soybeans. Some of the data for corn are shown in table 2. These results show that placing a 5-10-5 fertilizer in a narrow band at the bottom of the plow furrow resulted in larger increases in yield than broadcasting the fertilizer after plowing, the average difference being 5.1 bushels per acre. In the case of the experiment in Delaware County on O'Neil loam where the yield was nearly 9 bushels higher with the "plow-under" method, the difference may be due in part to the fact that the fertilizer applied after plowing was not disked into the soil but the field merely harrowed.

In these two experiments we also found that 100 pounds of fertilizer in the hill gave an average increase of 6.5 bushels, whereas 800 pounds of the same fertilizer plowed under gave an increase of 15.3 bushels. Apparently, the

TABLE 2. YIELDS OF CORN FROM SMALL AMOUNT OF FERTILIZER IN HILL AS COMPARED TO LARGE AMOUNTS BROADCAST OR PLOWED UNDER.

Field	Yield of corn (Bu/A) with different fertilizer treatments				
	None	100 lbs. in hill	800 lbs. broadcast after plowing	800 lbs. at bottom of plow furrow	100 lbs. in hill + 800 lbs. at bottom of plow furrow
O'Neil Loam Delaware County (1943)	45.4	52.2	55.3	64.1	62.4
Carrington Silt Loam Linn County (1943)	76.3	84.5	86.8	90.3	88.4
Carrington Silt Loam Linn County (Residual effect in 1944)	89.1	92.0	100.1	97.0	94.2
Average of two fields (1943)	61.9	68.4	71.1	77.2	75.4
Increase in yield over check		6.5	10.2	15.3	13.5

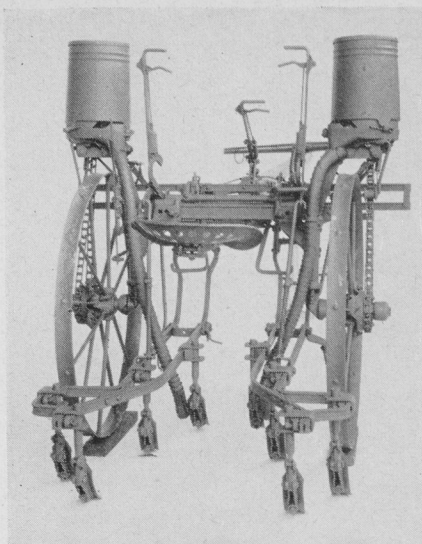
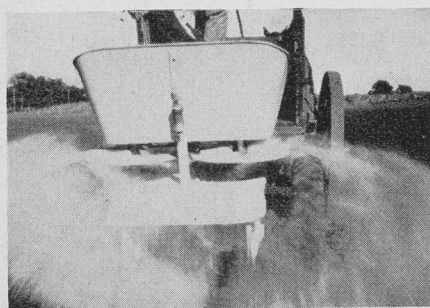
large amount of fertilizer plowed under was sufficient to get maximum yields, for the addition of another 100 pounds in the hill failed to give an increase.

The residual effect of the fertilizer on the yield of corn in 1944 was measured on the field in Linn County and found to be between 5 and 8.1 bushels per acre where 800 pounds of fertilizer had been used in 1943 and none used in 1944. The total increase for the 2 years was 21.9 bushels where 800 pounds had been plowed under, 21.5 bushels where the same amount of fertilizer was broadcast after plowing, and 11.1 bushels where 100 pounds of the same fertilizer was applied in the hill in 1943.

The question has been raised as to what results might be expected from broadcasting the fertilizer on the surface **and then plowing it under**. Our work during the past 2 years indicates that this method is satisfactory where large amounts of nitrogen fertilizers are used. It is not likely to be very satisfactory, however, for the common fertilizers used in Iowa, which consist mainly of phosphorus or phosphorus-potash combinations, especially if relatively small amounts are applied. This has been well shown by some experiments conducted at the Indiana and Ohio stations.

Where only small amounts (100 to 200 pounds per acre) of phosphate or mixed fertilizer are used, however, as in ordinary practice, it should be applied in the hill or row with planter attachment if it is to be used most efficiently. Even where the fertility of the soil is such that plowing under of fertilizer is economical, the use of a

One of the most common methods of applying fertilizer is with an end-gate seeder or a low lime spreader.



Side-dressings of fertilizer are sometimes applied to row crops by use of attachments to cultivators.

part of the fertilizer in the hill or row would generally seem desirable to promote early growth.

On the basis of the results that have been referred to as well as of work in other Corn Belt states it appears that the plowing under of fertilizer for corn in a band at the bottom of the furrow may be an efficient method where a relatively large amount of fertilizer, especially of nitrogen fertilizers, is needed.

Top-Dressing

The broadcasting or drilling of fertilizers while a crop is on the ground, usually a close growing crop, is referred to as top-dressing. The efficiency of this method depends primarily on the type of fertilizer needed and on the soil conditions.

Top-dressing of Nitrogen Fertilizers. Since nitrogen fertilizers applied on the surface readily move downward into the soil with rains, top-dressing is often an efficient method of applying nitrogen in close growing crops. Under Iowa conditions there are three major places where nitrogen top-dressings can often be made to advantage if the soil has received insufficient amounts of nitrogen through legumes or manure. These are: (1) On permanent non-leguminous pastures, (2) on bromegrass grown without legumes for

seed production purposes, and (3) on wheat or oats.

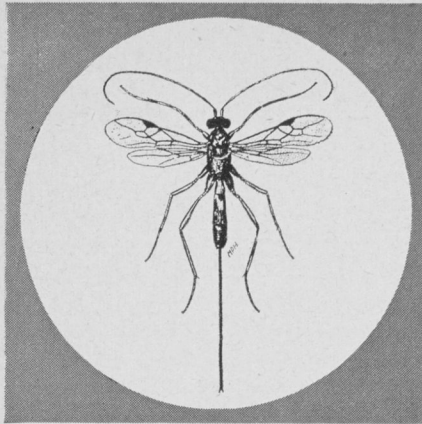
An example of the response that may be obtained on wheat and oats is shown by results we obtained in western Iowa during 1944, a wet season. The average increase in yield in these experiments from a top-dressing of 100 pounds of ammonium sulfate per acre was 4.9 bushels on four fields of wheat and 7.7 bushels on 11 fields of oats. With permanent pastures, the main value of the nitrogen top-dressing is in obtaining earlier grazing. Bluegrass pastures fertilized with nitrogen often are ready 1 to 2 weeks earlier than unfertilized pastures.

Top-Dressing of Phosphorus or Phosphorus-Potassium Fertilizers.

Because phosphorus and potassium fertilizers tend to combine with the soil, they move downward into the soil relatively slowly when applied as top-dressings. For this reason, the top-dressing of phosphorus and potassium fertilizers is usually not as efficient as applying the fertilizers at the time of seeding, when it can be incorporated deeper into the soil. Moreover, since these fertilizers are usually beneficial in the early growth of the plants, applications made at seeding time will help more to establish legume stands than will top-dressings at a later date.

Where alfalfa stands are kept for several years, however, top-dressings may sometimes be used effectively in maintaining the stand and increasing the yields. In northwestern Iowa, for example, top-dressings of phosphate fertilizer at the rate of 300 pounds per acre on alfalfa fields where the growth was very poor because of extreme phosphorus deficiency were found to markedly increase the yields. These soils, however, were all neutral or alkaline. Since acid soils combine more readily with phosphorus, or have greater "phosphorus fixation," top-dressing is not as efficient on acid as on alkaline or neutral soils.

For greatest efficiency, therefore, as much as possible of the phosphate needs of such leguminous crops as alfalfa and red clover should be incorporated with the soil at the time of seeding.



CORN BORER

In Threat Stage

Actual Damage in 1944 Was
Larger Than in 1943 But Not
Ruinous on Any One Farm

By C. J. DRAKE, H. M. HARRIS and C. C. BLICKENSTAFF

One of the four corn borer parasites liberated in Iowa last summer. These were set free in 14 counties.

ALTHOUGH THE European corn borer spread to many additional counties of Iowa in 1944 and more than doubled in population in the 20 counties where it was first found in 1942, the damage on individual farms was still not ruinous to any one farmer.

So we can say that the borer is still in the "threat" stage—not yet bad enough to cut deeply into Iowa's most important crop. In Muscatine County where the most borers were found this year, the average was about 126 borers for each 100 plants. This is not a heavy population when we compare it with areas in eastern states where the borer causes serious losses.

Federal workers who have been trying to find an accurate means of determining the damage have arrived at an estimate of 3 percent damage when borers average one per stalk. This means that in Muscatine County this year the damage on a 75-bushel crop of corn might have been a reduction of about $2\frac{4}{5}$ bushels to the acre.

On the farm of Clarence Taylor, Olin, Iowa (Jones County), we found about as heavy damage as in any field we were in this year. In spots of this field many of the stalks were broken over, but when we asked Mr. Taylor the actual yield of this field he said, "That field yielded about 70 bushels to the acre. I would estimate that the corn borers probably cut my yield about 7 or 8 bushels to the acre." As this field was hand-picked, the ears from the lodged and fallen stalks were saved. A mechanical

picker would not have gathered the ears from the ground nor on all the broken stalks, and the loss would have been greater.

That much cut in yield hurts when corn is worth about a dollar a bushel. It means a loss of \$7 or \$8 an acre. This is only an estimate and it might have been slightly higher or even less. If borers did that extent of damage to the entire corn crop of Iowa, it would be a substantial cut in the state's corn crop.

A survey of the 20 counties that were first found to have borers showed an average of 19.9 borers for each 100 stalks in 1943, but this jumped to 55.3 borers per 100 stalks in 1944. That is more than a double. We can't stand many doubles of borer population with-

out individual farmers feeling it, as well as severely cutting the state's total corn yield.

Iowa "Made" for Borers

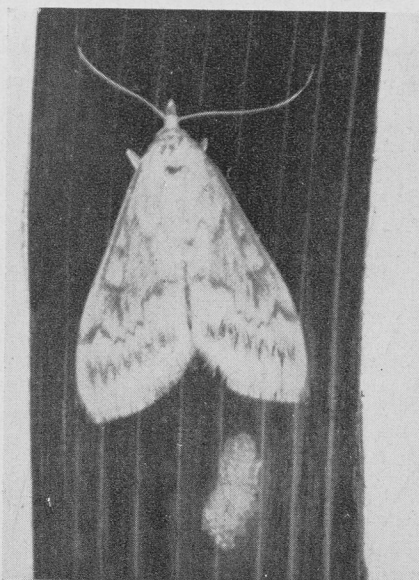
In many respects Iowa presents an ideal ground for the borer to "roll up his sleeves" and show what he can do. This is in part because we have such a large corn acreage in the state, partly because of our method of farming and partly because of our climate which makes these acreages and these methods possible.

In the eastern states where the corn borer first came into prominence, the corn acreage is small. The borer had to get out and "hunt up" fields in which to go to work. In Iowa, it doesn't have to hunt—there's just one field after another right in line.

In many of our eastern states, furthermore, very little corn is picked from the field with the stalks left standing. Most of it is cut for fodder and fed up, or is put in a silo where the borer dies. But in Iowa we pick most of our corn, leave the stalks standing, then in the spring work them down and sow a small grain crop. Borers in the stalks thus have a place to live over the winter and are at hand and ready to start work the next year.

Because of these differences, the corn borer has spread much more rapidly in Iowa than it ever has anywhere else. During 1944 we found borers in 88 of Iowa's 99 counties. It no doubt was in the others, though we failed to find it in the two which we scouted.

Adult female moth and egg mass on under side of corn leaf, enlarged nearly 3 times natural size.



Of course it is true that in many of these counties you had to really hunt hard to find the pest. That is true especially in the western half of the state. The maximum infestation occurs over along the Mississippi River—through Clinton, Scott and Muscatine, then extends on west through Cedar, Johnson, Iowa and Poweshiek counties. Both north and south of this tier of counties the intensity of infestation gradually decreases. It is only to about the middle of the state, however, that the borer is yet noticeable. It can be found in other counties but not in large numbers.

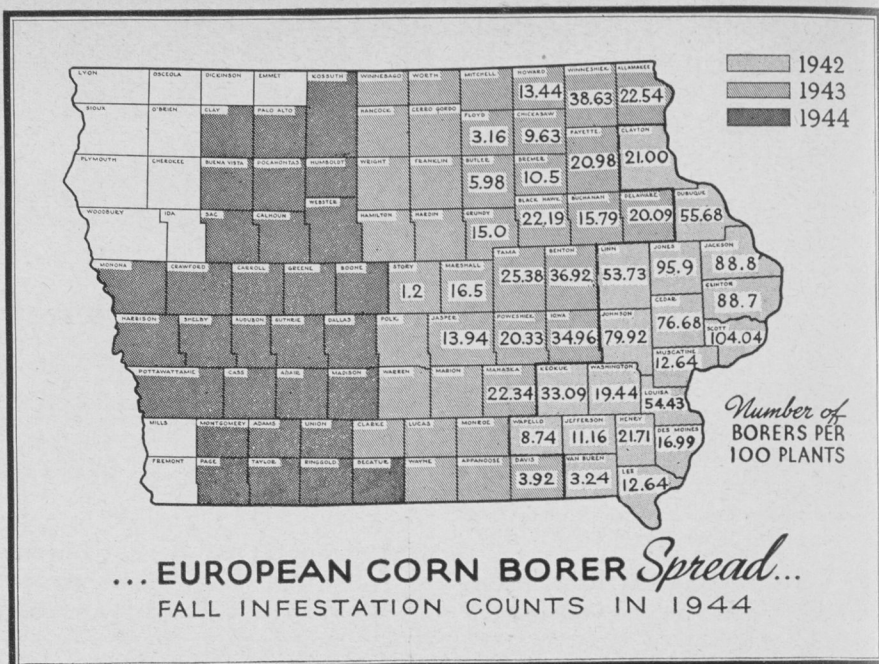
How much will the borer population thicken up in the counties north and south of this line? We don't know. Our opinion is that there will probably be some counties of Iowa and certain areas that will not have great trouble with this pest, but that remains to be seen.

There were fields in Marshall County this year which had heavier infestation than Jones and Cedar counties had last year. This indicates that in 1945—if conditions are right—a good many more counties may begin to feel borer damage than did last year.

Natural and Other Checks

There are some checks on the borer increase. For example, we do not know exactly how large a

Right to left: Gov. Robert D. Blue, C. J. Drake, Byron Umbdenstock and Harry D. Linn examining a field of late corn heavily infested with the European corn borer. Mr. Umbdenstock's farm lies 1 mile west of Marion.



percentage of the corn borers are killed by mechanical corn pickers, but we estimate that it may run as high as 20 percent and probably not less than 10 percent. There is a constant decrease in the number of borers from the time they hatch out. Weather and many other factors account for this decline. Hot dry weather at the time of moth flight causes many eggs to fall from the plants and results in death of many small borers before they can get into the plant. Such weather in Ohio, Indiana and eastern Illinois last year resulted in a great drop in borer population.

In southeastern Iowa the downy woodpeckers, we found, were working hard on the borers. Birds will play a part in holding down borer population. This past year we have liberated in Iowa many thousands of four different parasites that work on corn borers. Whether or not these will become established in Iowa, we do not know yet, but they seem to be one of the more promising "hopes" of helping nature to check borers.

It may take 4 or 5 years to build up a parasite population—if they become established—to feel their effect on borers. In the area of the New England states where these parasites were obtained as high as 35 to 40 percent of the borers were found to be infested with parasites. Many borers are killed by them. The parasites were originally brought in from Europe and the Orient and they have been in the New England states for 5 to 15 years.

Regardless of how well the parasites do, we cannot expect them to completely solve the borer problem. They should be looked upon as another possible help.

What Can Farmers Do?

The question of what the farmers can do to lessen the damage is yet somewhat on the trial basis. We do know that if **all** cornstalks were completely plowed under, put in a silo or shredded, that



would pretty well take care of any large build-up of borer population.

But there is a big question of whether we can afford to plow under our huge acreage of stalks each year. It would mean a delay in the sowing of small grain crops and would cut down yields because of the delay. Whether the added expense of plowing under all stalks would be profitable, no one can say now with certainty.

One thing we are rather certain of is that farmers will need to time their planting carefully—planting neither real early nor late. The exact time will vary with the area of the state and type of soil. A sandy soil that pushes corn along rapidly, for instance, will need to be planted later than a heavy black soil that doesn't warm up quickly. This also applies to rich, fertile soil and poor soil.

Another thing farmers need to observe, we are sure, is the hybrid they use. Light shanked varieties and those with a tendency toward weak stalks will not stand up under borer damage as will those with heavy, thick ear shanks and with stiff stalks. One borer may put the weak-stalked variety on the ground, or the ear of a light-shank variety may drop with only one borer working in the right place, whereas the sturdy stalk and heavy shank may be able to stand up under some borer damage much better.

We do not know of such a thing as a completely "borer-resistant" or immune variety, but there are

A Jones County hill of 1944 corn broken over as a result of tunneling of the stalks by corn borers.



differences and we hope to find the ones that can tolerate borer damage. Until these are found, the best thing for any farmer to do in a county heavily infested with borers is to use the variety that can be planted at a medium date and mature, but which is known to be stiff-stalked and has a good shank that will not drop its ears readily.

What's Coming?

One of the possibilities that may do much to solve our borer problem may lie with the agricultural engineer. If we can kill the borers by running stalks through a shredder, then why cannot a shredder be made part of the mechanical cornpicker? Machinery manufacturers are working on the problem, and Purdue University has developed a device that is attached to a mechanical cornpicker in such a way that it shreds the stalks at the same time it does the picking.

These devices seem to hold much promise, but they are still in the experimental stage and we cannot depend upon them until we know they will do what it seems that they can be made to do.

If such a machine can be perfected, then it may be possible to go on farming pretty much as we are—disking down our stalks or plowing them under according to what the next crop is to be.

As we see the borer picture at this stage—it is still a threat so far as farmers in general are concerned. The total damage done in the state has just been estimated by the federal workers. They say it is approximately 2 million dollars for 1944. So far as individual farmers are concerned, they have not yet felt very much the effect of the borer. But if it keeps on increasing its area and its population where it is now established, it could bring heavy losses.

The thing we fear is that some year, weather man and the borer and other conditions will be "just



Liberating four different kinds of corn borer parasites in a corn field near Clinton, Iowa, in June, 1944. The men left to right: H. M. Harris, Carl Blickenstaff, County Extension Director M. D. Lacy and State Entomologist C. J. Drake.

right," and when all factors "click" we could have a very, very heavy loss. In the meantime we shall work toward finding means of holding down the borer population and finding ways to decrease it if possible. There is no need for anyone to get too excited and conclude that Iowa is "finished" as a corn producing state. We shall continue to grow large acreages with high yields. We all need to be on our toes, however, against this common foe of our famous crop.

PIGS CAN "TAKE" DISEASED CORN

In experiments at the Iowa Station one lot of pigs was fed corn heavily infected with dry rot diseases alongside another lot fed healthy corn.

The two lots of pigs were as nearly alike as possible and were fed and handled exactly the same except for the corn.

The result was that the pigs on diseased corn did not make as fast gains nor did they gain as much per pound of corn, but they did not get sick and when slaughtered no ill effects could be found from feeding the moldy corn.

The experiment was repeated with results in both tests about the same.

IOWA SOILS *Need*

WE ARE NOT doing a very good job of keeping up the available nitrogen content in Iowa soils. We could step up our yields and we would get a lot more good from the phosphorus and potassium fertilizers which we use if we had more available nitrogen in our soils.

This is the conclusion we have reached here at the Iowa Station following a good many experiments—some of which were with nitrogen fertilizers, others with phosphorus, potassium and with mixed fertilizers.

Results of the Tests

1. Yields could be increased if we had more available nitrogen in the soil. The fertility of Iowa soils is not being kept up. We have not yet established a system of agriculture which will maintain the fertility of our soils.

2. Unless the supply of nitrogen in the soil is sufficient, we do not get the best response from additions of phosphorus and potassium fertilizers applied to corn and small grains.

3. A lack of available nitrogen is most likely to limit the yield of corn on sandy, light-colored and eroded soils.

4. The need for nitrogen may be satisfied by the use of rotations which provide for the more fre-

Would Increase Crop Yields and Help to Get Best Returns From Other Fertilizers

quent growing of legumes and by the conservation and use of manure.

5. Phosphorus fertilizer can best be used on the oat crop in which clover is seeded. In that way it is possible to get an increase in three crops—the oats, clover and the corn which follows the clover.

The Plant Food Picture

Just how much does a 100-bushel corn crop take from the soil? It takes about 160 pounds of nitrogen, 125 pounds of potassium and 40 pounds of phosphorus. Putting it another way, to produce 100 bushels of corn the soil must furnish the amount of nitrogen contained in 800 pounds of ammonium sulfate, the amount of potassium in 300 pounds of muriate of potash and the amount of phosphorus in 400 pounds of 20 percent superphosphate. If you have bought fertilizers, you know that's a pretty large bill.

The soils of Iowa have been depleted by heavy cropping and soil erosion to the point where maximum yields of corn cannot be obtained without the addition of some of the plant nutrients which have been removed. Nitrogen, the

nutrient used in largest quantity (and probably of greatest importance in Iowa), can be supplied in adequate amounts by growing legumes in the rotation and by the proper use of manure.

Need More Nitrogen

The results of 24 experiments which we conducted in western Iowa in 1944 (see chart on next page) show the importance of nitrogen in producing a high yield of corn. In six of the experiments where corn followed clover the yield was increased 2.5 bushels by 200 pounds of ammonium sulfate (containing 40 pounds of nitrogen) per acre applied as a side dressing. In 12 fields of corn the second year following clover the yield was increased 5.8 bushels. The average increase in yield on six fields in corn for the third consecutive year was 11 bushels. In other words, the soils became more and more deficient in nitrogen as the number of consecutive corn crops was increased.

The fact that the yields of second and third-year corn fertilized with nitrogen did not equal those of corn following clover was largely because not enough nitrogen fertilizer was added. A good first year's growth of sweet clover may add 80-100 pounds of nitrogen per acre, whereas only 40 pounds of nitrogen were applied in the fertilizer.

Experiments in both 1943 and 1944 on a variety of soils over the state indicate that a lack of available nitrogen in the soil is most likely to limit the yield of corn on sandy soils, the light-colored soils and the eroded soils. The dark colored, relatively level soils contain more nitrogen and are less likely to show a definite need for this nutrient when clover is grown infrequently. The response to nitrogen obtained in 1943 and 1944 un-

On this farm in Howard County the check strip on the left which received no fertilizer yielded 45.7 bushels to the acre, while that on the right treated with 100 pounds of 0-20-10 fertilizer produced 55.1 bushels.



NITROGEN

By C. A. BLACK and KIRK LAWTON

doubtedly was greater than it would be over a period of years because of the high rainfall in these 2 years.

Where to Use Phosphorus

A good stand and a high yield of clover are important in furnishing a liberal supply of nitrogen for the succeeding corn crop. This means that you should inoculate in all cases and use lime on acid soils. Where phosphate is to be used in the rotation, you may wonder whether you would get more benefit from applying the phosphate to the oats and clover seedling, to the corn or to both.

Since clover generally responds more to phosphate than does corn,

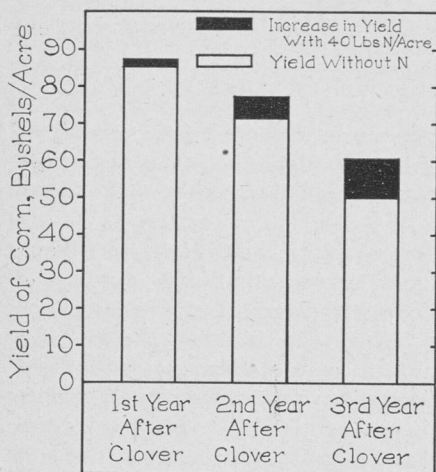
However, where the clover shows a good response to phosphate (which would indicate that the soil is low in available phosphorus) or potassium is deficient, the corn following will respond to additional fertilizer applied in the hill or row. In one of our Iowa Station experiments on the Agronomy Farm at Ames, superphosphate applied to oats at rates of 200 and 400 pounds per acre had no apparent residual effect on the first corn crop following the clover. An additional 100 pounds of superphosphate applied in the hill for corn increased the yield 8 bushels per acre.

Much superphosphate is used in the hill for corn. Superphosphate will increase the yield on many of the soils in the state. Judging from the results of over 80 experiments, however, the increase from 100 pounds per acre generally is not greater than 5 bushels and in many cases is not more than 2 bushels. Increases as large as 17 bushels per acre from 100 pounds of 20 percent superphosphate have been obtained in experiments, but such large responses are the exception rather than the rule.

One needs to keep in mind that phosphate won't be of much value on corn which is suffering from nitrogen deficiency. Only when the corn has a liberal supply of nitrogen can phosphate give its maximum benefit. This is shown in the results of 18 of our experiments where 100 pounds of 20 percent superphosphate per acre were applied to corn fields in western Iowa in 1944 (see chart page 16). These fields may be grouped into two lots—one which showed definite nitrogen deficiency (more than 10 bushels response to nitrogen) and one which showed little nitrogen deficiency (less than 5 bushels response to nitrogen).



On this farm in Pottawattamie County 200 pounds of ammonium sulfate increased the yield of corn from 36 bushels (right) to 50 bushels (left).



Greater increase is obtained from nitrogen fertilizer on second and third-year corn following clover.

the probability of receiving benefit from the fertilizer is greater if you apply it to the clover. More nitrogen will be fixed by a higher-yielding clover crop. This additional nitrogen may pay dividends later on the corn. There is the further possibility that some of the phosphate will remain in the soil to benefit the corn. Thus, with one application of phosphate there is a chance that three crops—oats, clover and corn—will be improved.

The average response to phosphate in the group of definitely nitrogen-deficient fields was only 0.1 bushel per acre. Where nitrogen was added, however, the increase in yield from phosphate was 3 bushels. If enough nitrogen had been applied to supply all the nitrogen needed, it is probable that the increase in yield from phosphate would have been greater than 3 bushels per acre. In the group of fields which showed little nitrogen deficiency, the average response to phosphate was 2.5 bushels where no nitrogen was used and 4.3 bushels where additional nitrogen was supplied. Even on these fields which gave only a relatively small response to nitrogen, the phosphate apparently could not be utilized to best advantage without additional nitrogen.

Potassium Helps Too

Corn takes a large quantity of potassium from the soil, and responds relatively well to potassium fertilizers. Yield increases up to 38 bushels per acre have been obtained from an application of 100 pounds of muriate of potash to corn grown on high-lime soils. Potassium deficiency is most likely to limit the yield of corn on the high-lime Webster soils of north-central Iowa, the sandy soils, and certain of the Clyde, Floyd and Carrington soils of northeast Iowa.

Most other Iowa soils contain large quantities of easily soluble

or exchangeable potassium and do not show the serious deficiency encountered in some of the high-lime soils. Where 10 pounds of potash have been used, such as in 100 pounds of an 0-20-10 fertilizer, few responses have been over 10 bushels per acre. This amount of potash has given an average increase in yield of approximately 5 bushels per acre in 58 experiments in eastern Iowa conducted during the past five years.

In 26 experiments conducted in 1944 on soils of western Iowa, considered to have higher quantities of available potassium than soils elsewhere in the state, the average response to an acre application of 10 pounds of potash in the row was 1.4 bushels.

As with phosphorus, we found that benefit from potassium is dependent upon an adequate supply of nitrogen.

Complete Fertilizers— Best Yield in 1944

In general, complete fertilizers containing at least 10 pounds of nitrogen gave larger increases in yield in 1944 than did nitrogen, phosphorus or potassium applied alone. The average acre increases from 39 experiments conducted in 1944 were 3.2 bushels from 100 pounds of 0-20-0, 3.5 bushels from 100 pounds of 0-20-10, 7.5 bushels from 100 pounds of 0-20-10 plus 10 pounds of nitrogen (50 pounds of ammonium sulfate), and 10.5 bushels from 100 pounds of 0-20-10 plus 40 pounds of nitrogen (200 pounds of ammonium sulfate).

Where corn shows a definite need for both phosphorus and potassium, the yield increase from a mixed fertilizer containing both of these nutrients should be larger than the sum of the increases produced by the two fertilizers added singly. You can get the maximum benefits from mixed fertilizers containing phosphorus and potassium only when the soil contains a liberal supply of nitrogen.

It is obvious from the data we obtained that where a real deficiency of nitrogen exists, the 2 to 4 pounds of nitrogen ordinarily applied in 100 pounds of such fertilizers as 2-12-6 or 4-12-4 are not enough. The small quantity of

nitrogen may, however, be of advantage where a little more rapid growth of the very young plant is important in determining the final outcome. When the soil is cold and low in nitrogen at the time of planting, the small amount of nitrogen in the fertilizer may satisfy the needs of the corn until the soil supply of available nitrogen becomes adequate for further growth. This condition is found in listed corn more often than in surface-planted corn.

Costs of Fertilization

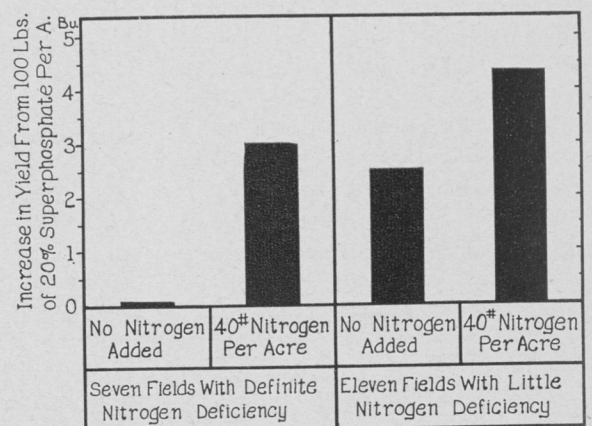
In most of our experiments, the amount of fertilizer added has been small compared with the total amounts of fertilizer constituents contained in the corn crop. The cost of fertilizer per acre (except for nitrogen) has been low, and only relatively small increases in yield are needed to make the applications profitable.

The present prices of the fertilizers employed in our experiments with corn are \$1.56 per acre for the phosphate, \$0.48 for the potash, and \$1.18 and \$4.73 for the 10 and 40-pound applications of nitrogen, respectively. With corn at \$1.00 per bushel, the yield increases required to cover the cost of the fertilizers would be 1.5 bu. for the phosphate, 0.5 bu. for the potash, and 1.2 and 4.7 bu. for the 10 and 40-pound rates of nitrogen.

If the results of all the experiments in 1944 are averaged together, all treatments have returned more value in corn than the cost of the fertilizer. The returns, however, varied considerably with the kind of the soil and the fertilizer used. On soils very definitely deficient in nitrogen, the largest profit was obtained from the treatment of 100 pounds of 0-20-10 plus 200 pounds of ammonium sulfate. The cost of this treatment was \$6.77 and the average yield increase on these nitrogen-deficient soils was 18.3 bu. per acre (average of all fields giving

a response of 10 bushels or more to nitrogen). On the other hand, the treatment of 100 pounds of 0-20-10 plus 50 pounds of ammonium sulfate was the most profitable on the fields in which corn followed clover. The cost of this treatment was \$3.22 and the yield increase was 6.4 bushels. In most seasons, however, the nitrogen applied in addition to 0-20-10 would have less effect on the yield of corn following clover. The most profitable fertilizer to use under these conditions would be 0-20-0 or 0-20-10.

We are certain that many Iowa soils are not giving maximum yields of corn. Experiments with



Greater increases in yield from phosphate are obtained when the soil has plenty of nitrogen.

commercial nitrogen fertilizers have shown that the supply of nitrogen often is not enough to produce the highest yields. To obtain such yields, legumes must be grown more frequently, more manure must be applied, or commercial nitrogen fertilizer used to fill the deficit.

If the soil has plenty of nitrogen, both phosphorus and potassium will increase the yields. With the fertility of all the soils built up with good soil management practices, 100-bushel yields of corn should be common on many fields, with 70 or 80-bushel yields on the majority of fields in years with favorable weather conditions.

A machine for harvesting sumac leaves and twigs has recently been developed at the Iowa Station. Sumac has been receiving more attention in the United States since the war began, and while importation of tannin was impossible.

SWEETCLOVER ON *Iowa* FARMS

It's Important As a Pasture Crop and for Keeping Up Fertility

DURING THE PAST 30 years sweetclover has changed from its lowly position as a roadside weed to a respectable place among farm crops. The rise in importance of this crop has been the direct result of the realization that sweetclover fills a most important role in building and maintaining our soils—making possible large yields of corn, soybeans and other crops.

Sweetclover during recent years has won a definite place in the cropping system on many farms, especially in 45 counties in north central and western Iowa. Two reasons for its popularity in this area are: (1) Its ideal adaptation to the high lime soils which prevail and (2) the speed with which sweetclover can recharge the fertility of the land in this region of high corn acreages.

We are now entering upon the fifth year of intensive food production. Last year many fields of corn showed signs of nitrogen deficiency due, in part at least, to the record corn crops which have been using up soil nitrogen faster than it is being returned to the land. This situation will be increasingly evident in the years ahead, as we get farther and farther away from the effects of plowed-down soil improving crops. To correct the situation we need to use sweetclover more extensively.

Soil Building Crop

As a soil building crop, sweetclover is especially desirable because of the ease with which stands are obtained when seeded with small grains or flax, the low cost of seed, the wide adaptation of the crop to the non-acid soils in the state, and the large amount of nitrogen and organic matter contained in its tops and roots.

Sweetclover is a biennial crop,

By I. J. JOHNSON, C. P. WILSIE and ALLAN T. LEFFLER



Sweetclover plowed under in the spring of the second year when the top has made a growth of approximately 6 inches insures a nearly complete kill, and it should add from 100 to 125 pounds of nitrogen to the acre.

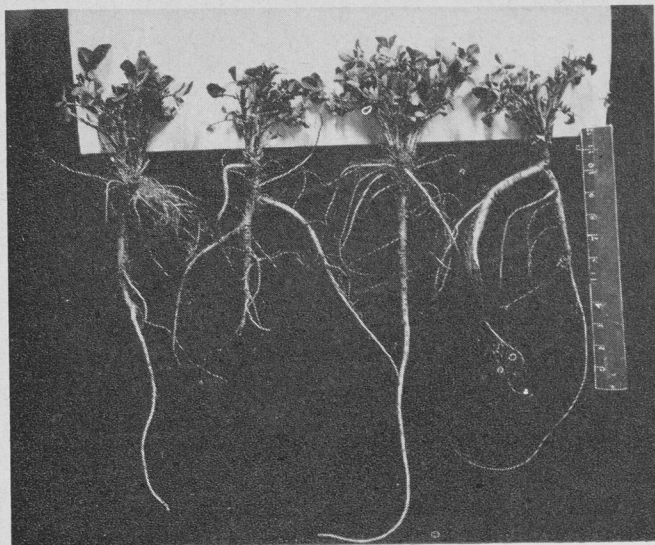
making a considerable root growth in the seedling year, living over winter, and making a large top growth the second year. As a legume it obtains a large proportion of the nitrogen required for its growth from the air, if properly inoculated. Studies on the chemistry of sweetclover show that it gathers great quantities of nitrogen the first year, stores it in the root system over winter and uses this plant food to start the early spring growth the following year.

Since nitrogen is the element most likely to limit corn production on heavily cropped soils, it's the element in which we are most interested from a soil improvement standpoint. There is no practical advantage in letting sweetclover grow to maturity in the second year unless one needs spring and early summer pasture,

or unless there is special need for an increased amount of organic matter in soils relatively low in fertility.

When to Plow

When should you plow your sweetclover? Our answer is: "Plow when the maximum amount of nitrogen will be added and so that it will not interfere with the proper seedbed preparation for planting corn at the normal time." This answer takes into account various factors such as the amount and type of organic matter added to the soil, the increase in soil nitrogen, the ease of killing the crop, and the effect upon soil structure and tilth. Fall plowing is practiced by many experienced sweetclover growers, but if done late enough to obtain maximum benefit to the soil, from the standpoint



Second-year growth of sweetclover comes from buds below the surface of the soil and draws on nutrients in the roots. The large tap roots to a depth of about 8 inches contain by the end of the first year nearly half of the nitrogen which the crop supplies.



Twenty plants make up each of the three sweetclover bundles above. The tiny bundle grew on acid soil without inoculation; the center bundle was inoculated but the soil wasn't limed. The large one was from limed soil and seed that had been inoculated.

of nitrogen added, there usually is enough survival of sweetclover in the second year to create something of an eradication problem.

Everything considered, plowing in the spring when the sweetclover has made a growth of about 6 inches is to be preferred.

Very early spring plowing should be avoided because this results in about the same amount of volunteering as when fall plowed. Generally, the plant is easier to kill after it has made about 6 inches of growth.

The last week in April is the most suitable time for plowing in most seasons. Plowing after the first of May might increase a little the total gain in organic matter, but it is hazardous in event of a dry season, as the growth of sweetclover uses up the winter store of subsoil moisture and makes the corn crop depend almost entirely upon current rainfall for its growth.

A normal stand of sweetclover can be expected to add from 80 to 100 pounds of nitrogen per acre under farm conditions. With a good stand and growth it may be considerably more. But this is as much nitrogen as is contained in 8 to 10 tons of barn manure, or in 400 to 500 pounds of ammonium sulfate. A clue to the importance of nitrogen in making corn can be

gained from chemical tests which show that the ears and stalks of a 100-bushel corn crop contain about 150 pounds of nitrogen.

The response of corn to sweetclover depends, in large part, upon the extent to which lack of nitrogen has limited production.

Effect on Corn Yields

We compared biennial sweetclover, hubam and red clover as green manure crops in a corn-oats rotation on Clarion loam at the Iowa Station, Ames, from 1923 to 1939. The experiment was so arranged that one-half of the total area was planted to corn and one-half to oats each year, with the legumes seeded in the oats. Yields of corn and oats were determined each year, and the legumes were sampled for yield of dry matter and nitrogen.

Yields of top and root growth were obtained from the plots of hubam and red clover in the fall when the growth had practically ceased. Biennial sweetclover plots were sampled in the spring of the second year just prior to seedbed preparation for corn. The legume growth and the crop residues from the oats and corn were returned to the soil. A summary of corn yields, expressed both in bushels per acre and in percentage of the

yield of untreated check plots, is given in table 1.

Recent work at Albia, Iowa, on Putnam silt loam has indicated a greater response from plowing under sweetclover than was obtained on the Clarion loam at Ames. In 1942, a year favorable for corn as shown by an 85-bushel crop on the check plots, the yield following sweetclover was increased from 6 to 17 bushels, depending on how the sweetclover was handled. In 1941, a year of poor corn yields, the check plots averaged about 36 bushels while on the spring-plowed sweetclover plots corn yielded 63 bushels, an increase of 27 bushels per acre.

Sweetclover green manure tests at the Illinois and Ohio stations

TABLE 1. YIELDS OF CORN IN A 2-YEAR CORN-OAT ROTATION ON CLARION LOAM AT AMES, IOWA, WITH DIFFERENT LEGUMES SEEDING IN OATS AND FALL OR SPRING PLOWED. 1923 TO 1939, INCLUSIVE.

Legume	Yield of corn (16-year average)	
	Bushels per acre	Percentage of check yield
Biennial sweetclover	60.1	113.8
Hubam	57.1	108.1
Red clover	55.7	105.4
None (check)	52.8	100.0

TABLE 2. POUNDS OF NITROGEN AND TONS OF DRY ROOTS AND TOPS PER ACRE IN SWEETCLOVER VARIETIES HARVESTED IN OCTOBER OF THE YEAR SOWN.

Variety	Pounds of nitrogen in roots and tops		Tons of dry matter in roots and tops	
	1940 and 42	1942-43	1940 and 42	1942-43
Iowa Late White	140	117	3.49	2.58
Madrid	155	116	3.50	2.55
Willamette	145	111	3.53	2.30
Wis. Late White	134	91	3.17	1.97
Spanish	133	92	2.95	1.87
Grundy County	134	.....	2.72	.....
Commercial	146	.....	3.00	.....
Evergreen	.....	109	.....	2.26
Sangemon	.....	101	.....	2.16
Average	141	105	3.19	2.24

show larger increases in corn yields than were obtained in the tests at Ames. On a dark colored soil at Dixon, Illinois, sweetclover in the rotation increased the yield of the following corn crop from 10 to 21 bushels as a 12-year average, the largest increase being obtained when all cornstalks and wheat straw were returned to the soil. An 8-year test at Wooster, Ohio, showed similar results.

Such great increases from plowing down sweetclover would not be expected on land capable of producing in excess of 75 bushels of corn in ordinary seasons, but the use of the crop to help maintain this level of production is worth considering until we are able to get back to more normal acreages of hay and rotation pasture crops.

Varieties' Fertility Values

Because of the value of sweetclover as a green manure crop, a study has been under way to determine differences among several varieties in respect to their nitrogen content and yield of organic matter at the end of the first year of growth.

During the 3 years 1940, 1942 and 1943, nine varieties were compared. These ranged from the early blooming Grundy County to the late flowering varieties such as Iowa Late White and Evergreen.

One variety of biennial yellow, Madrid, also was included.

The data presented in table 2 show that for the 2 years 1940 and 1942, Madrid, the relatively new variety of biennial yellow, was somewhat higher in pounds of nitrogen per acre at the end of the first year of growth, as determined by harvesting in October, than any of the others, although the differences were not significant. In tons of dry matter per acre, Madrid, together with the later flowering varieties, Iowa

Late White, Willamette and Wisconsin Late White, were superior to the earlier flowering white blossomed varieties, Grundy County and Spanish.

In the 2-year period 1942 and 1943, two additional late flowering varieties, Evergreen and Sangemon, were included in the tests. In most respects these two varieties resemble Iowa Late White. The data from this period show that late flowering varieties, with the exception of Wisconsin Late, were all essentially equal and that Madrid, although early in blooming, was equal to the late flowering types in pounds of nitrogen per acre.

Spanish, a medium early white blossomed variety, was low in yield of nitrogen. In tons of dry matter per acre, Madrid and Iowa Late White were significantly superior to Wisconsin Late, Spanish, Evergreen and Sangemon. In general, the late flowering varieties of biennial white and the yellow blossomed variety, Madrid, were superior to the earlier flowering white blossomed varieties in pounds of nitrogen per acre and in yield of organic matter at the end of the first year of growth.

Unfortunately, seed production of the late flowering biennial white varieties has been very poor—in many years a complete failure. This factor has been responsible

Sweetclover provides a large acre yield of nutritious pasture. Intensive grazing in May and June prevents too rank and woody growth. It preferably should be used in a mixture along with other legumes and grasses.



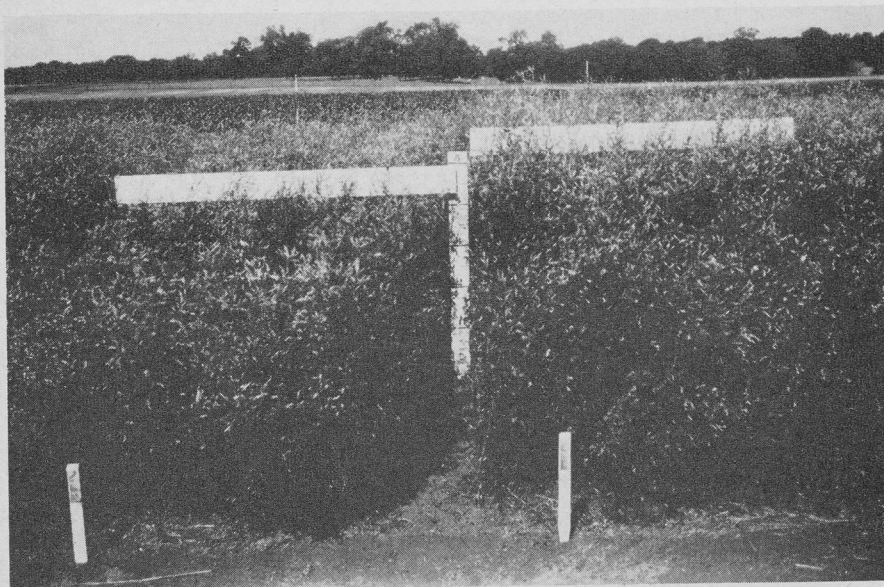
for the slow utilization of these varieties in the Corn Belt. In contrast, Madrid has produced abundant yields of seed. For this reason, and because of its very good performance as a green manure crop, this variety is being increased as rapidly as possible for distribution. Seed will not be available in quantity, however, for a few years.

At the present time our recommendation for using sweetclover in soil improvement is to plant with oats the standard biennial varieties for which seed is available, leave the sweetclover until the following spring and plow under the crop in preparation for corn following in the rotation. In fact, we'd recommend that every acre of oats that isn't being seeded to alfalfa or red clover mixtures should be seeded to sweetclover, provided only that the land is naturally high in lime or has been limed.

High Value for Pasture

Sweetclover gives a large acre yield of nutritious herbage for pasture, either when used alone as a rotation pasture crop on the level land in the heavy corn-producing counties or when grown in mixtures with grasses in the rolling or hilly permanent pasture areas of the state.

Sweetclover varieties differ in vigor, height, time of flowering, fineness of growth and yield of nitrogen per acre. Late flowering varieties stretch out the pasture season, and they also provide the most nitrogen when plowed under. The Iowa Station is searching for better varieties.



When sweetclover is used alone as a rotation pasture crop it may be expected to provide excellent grazing from late August until mid-October of the seeding year, although care should be used to avoid overgrazing. From 4 to 6 inches of top growth should be maintained to permit the accumulation of sufficient root reserves to safely carry the plants over the winter.

In the second year of growth, sweetclover usually is ready for pasture by the first week of May. A growth of 10-12 inches should be made before livestock are turned on, and the crop should be heavily grazed during May to keep the plants from becoming coarse and woody in the following months. Under ordinary farm conditions the amount of growth is only half as much in June as in May, is further reduced in July, and by the middle of August the second year growth is practically gone. By this date, however, the first year growth from new seedings should be ready for moderate grazing. The major objections to sweetclover for pasture when seeded alone are its lack of palatability when cattle are first turned into pastures and the danger of bloat. Cattle soon become accustomed to its somewhat bitter taste, and many farmers have found this

feature not to be a limiting factor in its use. There seems to be less danger of bloat when it is grown with a grass crop.

Sweetclover varieties vary widely in their value for pasture. The late flowering kinds have a longer period of productive growth than the early flowering varieties such as biennial yellow and Grundy County. When seed of the late flowering varieties, such as Iowa Late White and Evergreen, becomes available the value of sweetclover as a rotation pasture will be even greater than now.

Sweetclover also fits in well as a supplement to other pasture crops. During May, when the carrying capacity of sweetclover is at its height, the grazing of bluegrass pastures can be deferred for use during June and July when early grazed bluegrass pastures have passed their peak production. In areas where lespedeza is used for summer grazing the inclusion of a sweetclover pasture provides a source of needed legumes for the early part of the season.

Studies at the pasture research farms in Iowa also have demonstrated the value of sweetclover in pasture renovation. In these trials sufficient seed of the sweetclover plants has matured in the grass-legume mixture to maintain good volunteer stands for several years. But keep in mind that liming is necessary to maintain satisfactory stands in those areas where the soils are naturally acid. The inclusion of an aggressive legume crop—and no other is equal to sweetclover—increases the total production of pastures by providing additional nitrogen for the grasses in the mixture. The grasses in the pasture mixture are essential to prevent soil loss from erosion on the hilly soils the state.

Sweetclover will thus undoubtedly continue to be important among our crop plants. Its value in soil improvement when used as a green manure crop and its usefulness in pastures—alone or in combinations with grasses—make it a key crop for the food front on many Iowa farms.

The WHAT And WHY Of CERTIFIED SEED

By JOE L. ROBINSON and H. D. HUGHES

"IT PAYS to plant good seed and Iowa Certified means good seed."

That is the slogan with which some 600 Iowa producers of certified seed, cooperating with each other and with the Iowa State College Extension Service through membership in the Iowa Agricultural Experiment Association, are carrying the meaning of "IOWA CERTIFIED" to the farmers of Iowa and the Corn Belt.

Most Iowa farmers are somewhat familiar with the term "certified seed," but relatively few have a clear idea of all that certification means when applied to seed.

Who Does the Certifying?

Seed is certified in Iowa by the Iowa Agricultural Experiment Association. Membership in this organization is open to any Iowa farmer interested in the improvement of Iowa field crops, especially those interested in producing field crop seed of superior quality. This group establishes rigid standards of perfection which any seed grower must meet if his seed is to bear the blue tag, "Iowa Certified." The College cooperates with this association of Iowa farmer seed growers, giving every assistance

certified seed must be free from primary noxious weed seed and other seed of good quality. Seed of corn and beans are tested in soil and only those are counted as germinated which produce vigorous, healthy plants.



Inspecting a soybean field shortly before harvest. Soybeans, oats and other small grain and forage crop fields on which certification has been requested are inspected to make sure that there is no mixture with other varieties or with other crops. Only seed that is pure can be certified.

possible in advancing efforts to make available to Iowa farmers generally high quality seed of proven worth.

What Seed Are Eligible?

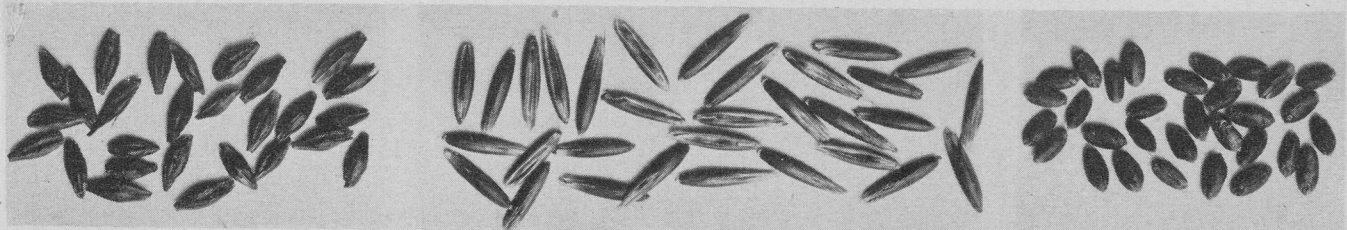
Certification is limited to varieties and strains of field crops which have been rigidly tested and proved to be among the most productive kinds and to be adapted to Iowa growing conditions.

Soybeans and small grain varieties to be eligible for certification

must have been shown to be superior in yield and in other characters in comparative plantings at the Iowa Station. Corn hybrids to be considered for certification must have been included in the Iowa Corn Yield Test plantings and must have stood among the very best in yield of grain and strength of stalk in one or more sections of the state.

The crops and varieties for which application for certification was permissible in 1944 (indicative for 1945) are as follows:

Corn Hybrids:—Iowa Hybrids 13, 303, 306, 931, 939, 942, 3088, 3110, 3553, 4020, 4059, 4060, 4316; Illinois Hybrids 201, 247, 374, 751,



960, 972; Indiana Hybrids 416B, 432, 608B, 608C, 610; Ohio Hybrids K35, C92; U. S. Hybrids 5, 13, 35, 44, 63, 65. (Provisional: Iowa Hybrids 4049, 4249, 4295, 4297, 4298; Indiana 210B; Ohio A24.)

Oats:—Boone, Marion, Tama, Vicland.

Winter Wheat:—Iowin, Iobred, Iobred—73.

Flax:—Redwing, Bison, Biwing.

Soybeans: — Mukden, Richland, Chief, Dunfield, Lincoln, Earlyana.

Red Clover:—Midland, Emerson.

Sweetclover:—Iowa Late White.

Bromegrass: — Fischer, Lincoln, Achenbach, Iowa.

Lespedeza:—19604.

Iowa Certified Requirements

True to Variety Name. To be eligible for inspection looking to certification a field must have been planted with either foundation or certified seed, tracing back to the originator of the strain or variety. This, together with rigid inspection of the crop in the field as well as the seed in the bin after harvest, gives real assurance to the buyer that he is getting seed of the variety that he wants.

Free From Mixture. All small grain, soybeans, grass and other crops grown for seed on which certification has been requested are inspected in the field when in full head stage of growth for evidences of mixture with other varieties or with other kinds of grain, beans, or grass, as the case may be. Oats, to be eligible to bear the blue tag "Iowa Certified" must

have a varietal purity of at least 99.5 percent. Soybeans can show not to exceed .2 of 1 percent of varietal mixtures in the field. And so it is with other seed.

Corn hybrid seed producing fields must be so isolated as to keep the possibility of pollination by stray pollen to the minimum. Distances to other plantings of corn are carefully inspected and measured. During the detasseling and pollinating period these fields are visited at irregular and unannounced times by inspectors employed by the Association, to make certain that a thorough job of detasseling is done. If, at the time of any inspection, as many as one tassel out of 100 in the ear producing rows is found to be shedding any pollen the field is not eligible for certification. In the 1944 season each hybrid corn seed producing field listed was inspected from 3 to 11 times.

Freedom From Weed Seed. One of the prime purposes of field inspection of the growing seed crop is to guard against noxious weeds. Seed crops must be entirely free of all primary noxious weeds to be eligible for certification. After the crop is harvested and threshed the bin is thoroughly sampled and the seed further examined for the presence of weed seed. To pass for certification the seed must be entirely free of all primary noxious weed seed and must not have more than a minimum number of secondary noxious, or of other weed seed.

Only those crops and varieties are eligible for certification which have proved productive and otherwise superior through a period of years in comparative plantings. Many such tests are made at the Iowa Station.

Adapted to Iowa Conditions. All varieties, strains and hybrids eligible for inspection looking to certification must have been shown to be well adapted to Iowa growing conditions. Hybrid corn must have been entered in the Iowa Corn Yield Test and have matured satisfactorily, producing a good quality of grain. Soybean and small grain varieties must have been included in comparative variety plantings through a period of years and have been shown to be well adapted.

Proved Productivity. Only those varieties which have proved to be superior in production can bear the blue "Iowa Certified" tag. Varieties of soybeans, small grains, clovers and grasses are tested and compared year after year in breeding and variety plantings at the State Experiment Station. Only those which stand at the very top in production are placed on the list of varieties eligible for certification. A corn hybrid to be eligible for certification must have been among the very top in yield in the Iowa Corn Yield Test and also must have shown superior resistance to stalk breaking and to lodging. The planting of certified seed helps to assure the very best yields that the soil and season make possible.

Strong Germination. With genuineness, adaptation, productivity, freedom from mixture and from weed seed established, there is still the matter of strong germination. For all lots of seed which have



passed these mentioned hurdles, a representative of the association takes samples from the stocks of seed in the hands of the growers and tests these for germination in the College Seed Laboratory. Here seed is tested in soil, and only those counted as germinated which are capable of growing into healthy plants. To carry the blue certification tag a high percentage of the seed must have been shown capable of producing healthy plants.

Certified Seed Available

Over 29,000 acres of hybrid corn seed fields were inspected for certification in 1944, over 9,000 acres of oats, 3,000 of soybeans, and smaller acreages of lespedeza, bromegrass and flax. The percent of the acreage of these different crops which passed the field, bin and laboratory inspection tests for certification in 1943 (1944 probably will show similar results) was 91 percent for corn, 46 for oats, 47 for soybeans, and 68 for bromegrass.

The fact that over half of the acreage of soybeans and oats and nearly a third of the acreage of bromegrass failed to meet the requirements for certification indicates the care exercised by the inspectors of the certifying agency and the high standards of seed certification in Iowa. When half these fields on which certification had been asked by the owners fail to meet the certification requirements—freedom from mixture with other varieties and other grains—and from noxious weeds—high germination—true to name—adapted and productive—we can be pretty sure that much of our uninspected small grain and bean seed is far from good quality.

A booklet issued by the seed certifying agency entitled "Know the Seed You Plant" lists the growers from whom certified seed of the different crops can be obtained. This can be had by addressing the Iowa Agricultural Experiment Association, Ames, Iowa.

Certified Seed Top Yields

It should not be inferred that all uncertified seed of these im-



Hybrid corn seed fields for which certification has been asked are repeatedly inspected at unannounced times during the period of detasseling to insure seed of the highest possible value. Such fields must be well isolated from all others which might be able to contaminate them.

proved varieties and hybrids is unsatisfactory in quality. Much, if not most, of the hybrid corn seed sold in Iowa is believed to be of good quality. Probably somewhere near half this seed is not certified. We believe that most of those who produce hybrid corn seed are making an earnest effort to provide their customers with high quality seed, though the relative productivity of many of these hybrids has not been established by entry in the Iowa Corn Yield Test. Probably a much smaller proportion of the uncertified small grain, beans and grass seed is of satisfactory quality than is true for seed corn.

Maximum acre yield is the aim of all of us who grow crops. Almost any seed will produce some sort of a crop. But questionable seed—seed of unknown origin or adaptation; perhaps diseased and of poor germination; perhaps poorly adapted and of unknown productivity, that is mixed or contains weed seed—cannot be depended upon to give a full return on the investment in the land, and in time, labor and actual cost of plowing, fitting, planting, harvesting and marketing.

The planting of certified seed insures: trueness to variety name—freedom from mixture—freedom from weed seed—adaptation to Iowa conditions—proved productivity—strong germination.

Yes—"It pays to plant good seed and Iowa Certified means good seed."

TROUBLE WITH PIGS REARED ON CONCRETE

Some Iowa farmers have found that raising their pigs on concrete—keeping them always off the ground—is not the entire solution to producing good healthy pigs.

These pigs in many instances have had scours and scurvy-rough skins. At older ages they frequently show lameness and just "don't do well."

The trouble is believed to be a vitamin B-complex deficiency. Usually the feeding of fish meal (when it can be obtained) will bring the pigs out of it, according to C. C. Culbertson of the Iowa Station.

Iowa farmers have shown a growing interest in rearing their pigs on concrete because of the trouble with worms and diseases which they pick up from contaminated soil.

One Iowa farmer has had very good success over a period of years rearing pigs on concrete. He has fed skim milk in rather large quantities and plenty of good green alfalfa meal, in addition to fish meal. These additions to the rations have probably supplied the elements of nutrition which have caused trouble in many other herds.

New Sweet Corn Hybrids

For Cannery

THE VEGETABLE Crops Subsection of the Iowa Agricultural Experiment Station will release the inbreds for production of three new white sweet corn hybrids in February, 1945. The hybrids are for the commercial canner and not recommended for the home garden. Most people prefer early maturing yellow roasting ears for table use, so, since these hybrids are late maturing and white, they will not be popular for roasting ears.

Their value to the canner is in the yield and high cutting percentage of corn. They have been tested in various parts of Iowa for 3 years and have proven to be adapted anywhere in the state.

The hybrids are named Iogreen 56, Iogreen 16 and Iogent 11. The first two are narrow-grain Evergreen hybrids, and Iogent 11 is a Country Gentleman type hybrid.

Iogreen 56 is a medium late maturing hybrid, with stalks 8 feet or more tall, large ears with an average of 18-26 rows of corn and fairly resistant to smut. The ears taper slightly from butt to tip. The hybrid is a single cross, 3005 x 3006. The inbreds are large

By E. S. HABER

vigorous inbreds and will be satisfactory from the seed production standpoint.

Iogreen 16, row number 16-22, is similar to Iogreen 56, but the ear does not taper. Some canners object to the tapered ear of Iogreen 56. In other words, Iogreen 16 has a more desirable ear-shape and Iogreen 56 has a more desirable kernel as it is narrower and longer.

Comparisons with each other and other hybrids are given below:

THREE YEAR AVERAGE

	Yield (Tons per acre)	Cutting percentage
Iogreen 16	4.70	36.4
Iogreen 56	4.65	37.6
Iogreen 91	3.87	29.8
Illinois 14 x 13	3.52	28.6
Illinois 14 x 11	3.76	29.4

Iogent 11 is an improvement over Iogent 27, a hybrid in production for over 5 years. The inbreds used to produce this single cross are 4011 x 1627. The latter cross was released about 7 years

ago and is one of the parents of Iogent 27. Inbred 4011 replaces one of the old released inbreds. Iogent 11 will yield $\frac{1}{2}$ ton more per acre and is more widely adapted to various degrees of soil fertility and soil types. It will be easier for the seedsmen to produce this hybrid than Iogent 27 as both inbreds are planted at the same time and more seed is secured. The cutting percentage is as good or better, the corn has all the fine canning qualities of Iogent 27.

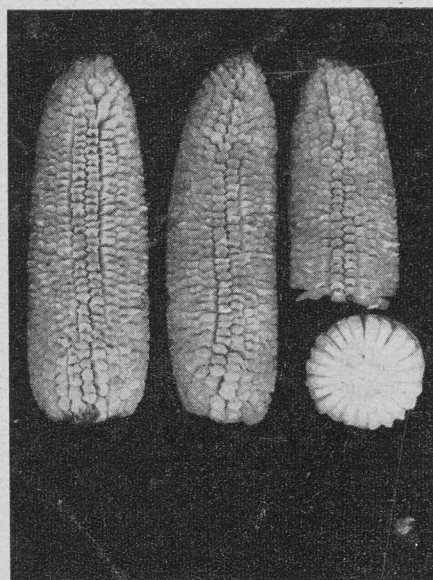
Comparison with other Country Gentleman type hybrids is given below:

THREE YEAR AVERAGE

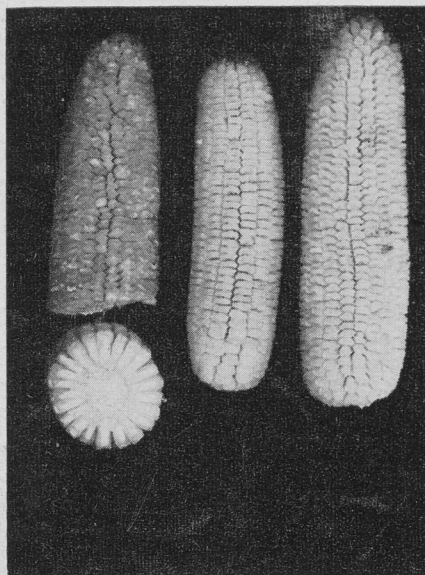
	Yield (Tons per acre)	Cutting percentage
Iogent 11	4.29	38.0
Iogent 27	3.69	35.2
Silvercross C. G.	3.35	33.8
Illinois 8 x 6	2.77	34.4

The hybrids are an improvement over existing hybrids used by the commercial canner, but again we wish to emphasize that for home use better golden hybrids are available.

Iogreen 56



Iogreen 16



Iogent 11

